

CHEMICAL AGE DEPT.

Chemical Age, September 5th 1942. WITH METALLURGICAL SECTION

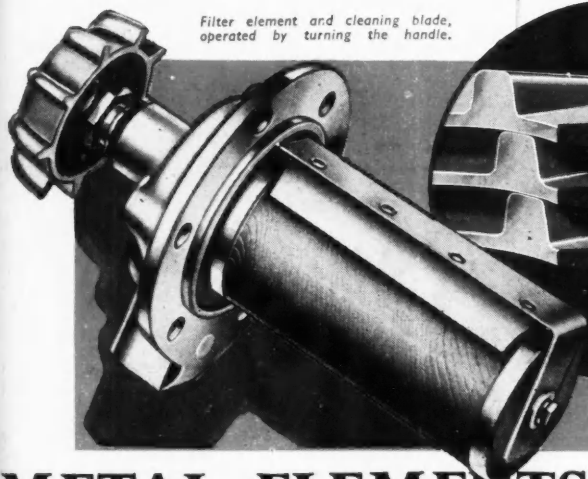
The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XLVII
No. 1210

SATURDAY, SEPTEMBER 5, 1942
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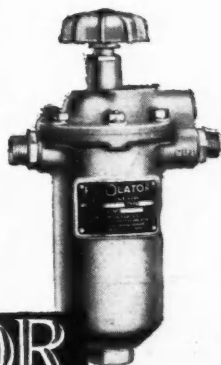
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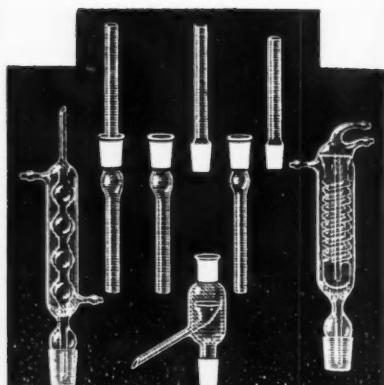
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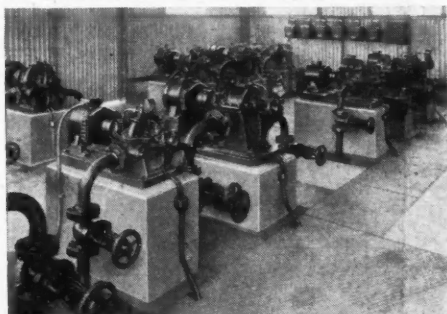


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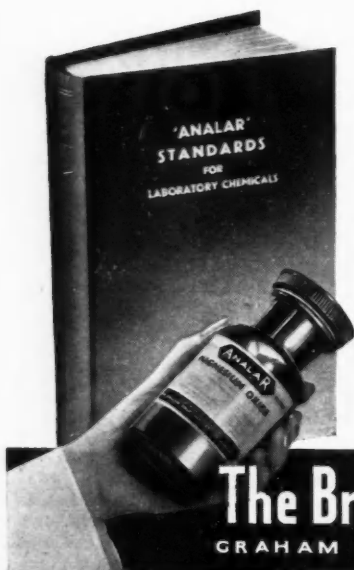
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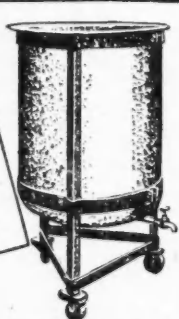
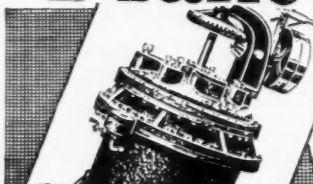
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September 5, 1942

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Prospecting for Minerals

IT has been said that all the minerals of economic importance can be discovered by the optimistic geologist working in conjunction with the pessimistic physicist. The optimism of the geologist and the pessimism of the physicist were both neatly illustrated during the course of the discussion between the Institute of Physics and the Geological Society which dealt with the geophysical methods for the discovery of minerals of economic importance. Four of these methods are in general use and all of them depend upon some physical change in the behaviour of the upper layers of the earth caused by the presence of considerable masses of material having different physical properties from the remainder of the rocks with which they are surrounded. The electrical method is based on the application of a current at a point in the earth's surface and the determination of the conductivity of the layers through which the current passes by the aid of instruments placed some distance away. Several points for admission and reception of the current are selected and it is found that from the indications of the equipotential lines at the earth's surface the presence of a mass beneath the surface of different conductivity

can be detected. An extension of the method permits the depth of a conducting layer to be determined. The magnetic method which is also used is similar in that the horizontal and vertical components of the magnetic field, the dip and the inductance, are determined, from whence the lines of force can be plotted. A distortion of the lines of force indicates the presence of a magnetic mass. This method is obviously of special use for investigating the presence of iron ores and other magnetic materials. An interesting recent development of this process indicates that certain deposits of ores are magnetised in a direction quite contrary to that of the present magnetic field of the earth and it may be that from that we can determine the age of the material; however, that is not yet certain.

The gravitational method which is frequently employed involves the use of a torsion balance by which the equi-gravitational surface over a given area can be plotted. If these surfaces are regular the indications of the method are negative; but any heavy mass lying beneath the surface will distort the gravitational lines. Another instrument known as a gravity meter may be used in place of the torsion balance and this is to

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be preferred for deep-seated masses because the effect of a mass on the torsion balance varies as the cube of its distance away, whereas the effect on the gravity meter varies as the square of its distance. Perhaps the method most frequently used to-day is the Seismic method, which as its name implies involves passing through rock group waves which are either reflected from a surface of discontinuity or are refracted through this surface into the underlying mass and subsequently again reflected upwards, being then subject to a second refraction on again passing through the surface of discontinuity, finally reaching the surface proper where they are registered by instruments. Whether the reflection or the refraction method is used, the principle depends upon the time taken for the waves to flow from the given point at which they originate to the several points at which they are received. The reflection method gives the position of the deposit, and the refraction method appears to indicate also to some extent the nature of the rocks. It is a weakness of geophysical methods generally that they do not indicate the character of the deposit, but only that there exists a deposit different in properties from that of the surrounding rocks. When the Seismic method is used a charge of several tons of dynamite is fired off from the selected spot in order to provide the waves which are to be measured.

In addition to the limitation of not detecting the nature of the rocks which produce the anomalous results, geophysical methods are limited in other directions. They are still in their infancy, of course, and there seem to be signs that if two of the methods are used together an indication showing the difference of specific gravity, of porosity, or some other factor may enable a shrewd guess to be made as to the nature of the deposit. Another essential limitation of the methods is that they are expensive. The days when a prospector went off into the blue with a couple of horses, a tent, a bottle of acid and a geological hammer in order to prospect for minerals represented the cheap era of the discovery of ore deposits; it was cheap in monetary cost though it was not necessarily cheap in

lives, because many of those who discovered for our use the valuable minerals of the earth left their bones to mark the utmost limit of their travels. To-day, the earth's surface has been so well prospected that more delicate methods are required. The geologist can indicate the probable site of any particular type of deposit. The geophysicist can correct or amplify his findings, but the two together working in harmony are the strongest team.

Because of the high cost of geophysical exploratory work it has been used only when deposits of great value are to be investigated. It is true that the geological survey of Great Britain has done a great deal of work on the determination of the geological features of the country by geophysical methods and has investigated the possible beds of iron ore deposits by the same methods. In a civilised and industrialised country the methods may not be so expensive, particularly when they are based on electrical or magnetic means. When, however, the geophysicist has to go far afield and to transport his instruments, his generators, his dynamite and so forth, into wild and desolate countries, the expense begins to mount up rapidly. Moreover a: several tons of dynamite perhaps have to be fired at a time for each series of observations it is evident that the cost of the methods may become almost prohibitive. It is probably for this reason that 80-90 per cent. of the geophysical work now being done is in connection with the discovery of oil. That has been its greatest achievement and evidence was given at the meeting of the striking rise in productivity of certain areas of the U.S.A. which had apparently been worked out until geophysical methods, with which the name of Professor Iling should be associated, had been applied. There appears to be springing up a geochemical technique also in which the radioactivity of the strata provides correlation data, and in which, to quote another example, the presence of oil, metals and other substances adsorbed in vegetation on the surface may be used to reinforce purely geophysical indications of deep-seated deposits.

NOTES AND COMMENTS

Germany's Need of Chemists

IN spite of the policy of enslavement adopted by the Nazis in the territories they have overrun, there is evidence of an acute shortage of man power in Germany. It is skilled labour that the Nazis lack most markedly—workers who must be trained before they can add their efforts profitably to the national economy. And this is the type of workman who is best able to make his reluctance to accept Nazi conditions felt. Skilled metal workers are being taken from the French factories and placed in German factories. We can anticipate that they will not be as efficient far from home in a Nazi workshop as they would be in France. It is said that there is special need in the German war machine for workers for their chemical and aluminium factories. A reading of the Air Ministry communiqués of recent months would soon convince any French chemist or metallurgical worker who might be considering the advantages of a position in a German factory that the dangers of acceptance are even more fearful than the penalties of refusal.

The Nazi Way

WE have shown in recent issues of THE CHEMICAL AGE how the complicated machinery of commerce on the Continent is groaning under the increasing difficulties of raw material shortages and the even more crippling burden of distrust. The neutrals must trade to live, but they have found that commercial dealing with the Nazis is, in fact, not very much better than extinction. The Swiss chemical industry, as we have pointed out, has sought to solve its difficulties by State control of some commodities and the development of domestic raw materials. Another indication of the complete lack of confidence in German contracts comes in the form of a report that thousands of tons of coal recently sent to Portugal originated in France. Germany, it is known, needs Portuguese wolfram and tin. Is the solution that Portugal will trust the Nazis no longer and that Hitler is, as usual, finding an easy way out by exchanging for something he needs, a commodity which belongs to somebody else?

Potato Products

A DEMAND has been voiced in the Australian technical Press for the establishment of a potato-products industry. It is stated that attempts have been made in the past to found such an industry in the Commonwealth, but that these invariably failed through timidity and lack of capital. With war expenditure on a large scale devoted to the building-up of new industries in Australia and elsewhere, it would seem that the potato-products industry has a fair claim to consideration. It is well known that it plays a large part in the war-time economy of Germany, and that potato starch, dextrine, and potato alcohol are of the highest importance to the Nazis. The technology is understood, the raw material is available and can keep pace with expansion, and a market is assured. Courage and enterprise are all that is required, and the merest glance at Australia's record shows that there is no lack of those qualities at need. It is a far cry from the small purplish tubers with deep-set eyes that were imported into Europe from the Andean foothills nearly 400 years ago, to the fat and succulent edible potato of to-day. The question is, why have we stopped there when the industrial raw material is also available in the shape of discarded culls? Had we had the products, whether here or in Australia, they would have been invaluable in war; and there is an opportunity here for a flourishing post-war industry.

Explosives

REACTION from the modern tendency towards closer and closer specialisation has recently taken the form of complaints that too little attention is being paid by scientists to the world outside their own. At the last meeting of the Society of Chemical Industry, Sir John Russell, in his address, lamented the lack of knowledge outside their own subject, exhibited by research workers in chemistry. He thought that the inability to express themselves was often at the bottom of the neglect of which they sometimes complained. Other voices have been raised since on similar lines and, for this reason, it is particularly refreshing

to pick up a book dealing largely with chemical matters which is as admirably written as it is informative. The book is called "Explosives" and is published as a Pelican Book. It is written by Dr. John Read, Professor of Chemistry in the University of St. Andrews.

"Finding" Chemistry

IF workers in chemistry neglect to inform themselves of activities beyond their own immediate interests, it is certainly true that the layman still prefers to wonder at, rather than to understand, chemistry. As Dr. Read says, with his mounting mastery over material man has grown more and more chemistry-conscious. But "this does not mean that the average educated man of the twentieth century is as yet conscious of a knowledge of chemistry." The fact of the matter is that the "average educated man" does not long remain such in these days, being very soon specialising himself to an extent which gives him little time to continue his education in other directions. But much can be done to meet this lack of leisure for developing interests outside one's own subject. Books can be written which deal fully, intelligently and yet simply—not despising that lightness of touch which staves off

fatigue—with matters usually regarded by the layman as "difficult." Dr. John Read has rendered an important service in this direction.

X-Ray Diffraction Data

THE method of identifying substances by means of their X-ray diffraction patterns is being increasingly used, and at a recent X-ray conference held in Cambridge, examples of the applications of this technique to industrial problems were cited dealing with refractories, ferrous and non-ferrous metals, organic and inorganic chemicals. The American Society for Testing Materials has prepared a card index of diffraction data for about 1300 substances, in a form suitable for use in chemical analysis by the method. The actual cards are reproduced by a photographic process from originals partly printed and partly written by hand. It is proposed, says the Institute of Physics, either to obtain a number of these indexes for use in this country and to supplement them with cards covering 300-500 other substances for which information is available, or to prepare a British index on similar lines. Inquiries should be made to Dr. A. J. C. Wilson, F.Inst.P., Crystallographic Laboratory, Free School Lane, Cambridge.

Paraffin Drying Oils

Replacing Vegetable Oils by Mineral Products

THE growing shortage of vegetable oils has caused German chemists to study the possibility of replacing tung oil, linseed oil, etc., by suitable mineral products. It is claimed that satisfactory drying oils can be obtained from high-molecular hydrocarbons, such as paraffin wax, ozokerite and ceresine, paraffinous residues, and even crude lubricating oils with a high hydrogen content, if these are treated with metal or boron halides together with acid halides. It is, for example, proposed, to dissolve 100 parts of a product obtained by repeated cracking of paraffin wax at a temperature of 500° C. in 30 parts of ethylene chloride, to add 30 parts of aluminium chloride and allow 15-20 parts of phosgene to react with the mixture for several hours at a temperature between 50° and 60° C. Next the aluminium chloride is dissolved with dilute hydrochloric acid, the aqueous solution removed, and the solvent separated from the reaction product by distillation. The resulting 90 parts of drying oil have an iodine

value of 115. The raw material for the process may also be obtained from cracking gases, and the ethylene chloride can be replaced by carbon tetrachloride. The most suitable metal halides are the chlorides of aluminium, zinc, iron, and titanium. Boron fluoride is also considered satisfactory for the process. Iodine values between 100 and 160 have been obtained. The mineral drying oils can be used alone or mixed with vegetable oils, and the drying time can be shortened by means of the oxides, acetates, and borates of lead, cobalt, and manganese.

DR. S. G. BARKER, O.B.E., scientific adviser to the Indian Jute Mills Association, Calcutta, died in Edinburgh on August 28. In 1934 he was medallist of the Society of Dyers and Colourists. He was a member of the Institute of Chemical Engineers, of the Faraday Society, of the Imperial Institute Committee on Vegetable Fibres (1938), and of many other learned societies and bodies.

Steam Economy and CO₂—II

Thermal Conductivity Meters

by D. D. HOWAT, B.Sc., Ph.D., A.I.C., A.Inst.M.M.

(Continued from THE CHEMICAL AGE, August 29, p. 204)

IF a constant electric current is passed through a platinum wire surrounded by a gas in a chamber, the final temperature of the wire will depend upon (a) radiation of heat, (b) convection currents, and (c) thermal conductivity (1) by the surrounding gas and (2) by end losses from the wire to the instrument.

The following table of comparative values of the thermal conductivity of the components normally present in flue gases shows that CO₂ has a value only about half that of any of the others.

Thermal Conductivities of Gases

| (Air: 100) | | | |
|-----------------|-----|-----|-----|
| Water vapour | ... | ... | 130 |
| Oxygen | ... | ... | 101 |
| Nitrogen | ... | ... | 100 |
| Carbon monoxide | ... | ... | 96 |
| Carbon dioxide | ... | ... | 59 |

The presence of even small amounts of CO₂ in flue gases will therefore reduce the thermal conductivity of the mixture to a pronounced degree. The value of the thermal conductivity may therefore be employed in measuring the CO₂ content provided that errors due to other sources of heat loss are reduced to very small proportions. Radiation losses are kept low by maintaining the heating current and, consequently, the temperature of the wire at very little over 100° C. Convection currents in a tube of small diameter are so small as to be negligible. End losses may be reduced greatly by suitable design in the instrument.

The general lay-out of the instrument shown in Fig. 3 comprises four identical platinum wire spirals enclosed in separate cells, E₁, E₂, E₃ and E₄, in a solid metal block, each spiral forming one arm of a Wheatstone Bridge circuit. A constant electric current flowing through the circuit heats the spirals. If all four spirals are surrounded by the same gaseous mixture the loss of heat to the walls will be equal and no deflection of the galvanometer (G) will be experienced. If a gaseous mixture with a different thermal conductivity is introduced into two of the cells, say E₁ and E₃, the rate of heat

loss from the spirals in these cells will be different from that in the remaining two cells, E₂ and E₄. The temperature of the two pairs of spirals will therefore be different, and this in turn will cause

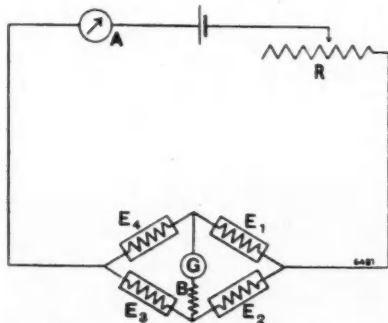


Fig. 3. Wheatstone bridge principle as applied in thermal conductivity CO₂ meters.

a variation in the electrical resistance of the four arms of the bridge circuit. The galvanometer will therefore be deflected to a degree depending upon the difference in conductivity of the two gaseous mixtures. The construction of the instrument is such that changes in the resistance affect both sides of the bridge equally. If, therefore, the cells E₂ and E₄ contain a gas of high conductivity value, such as air, and cells E₁ and E₃ contain air mixed with CO₂, the extent of the deflection of the galvanometer will furnish an indication of the amount of the second gas present. The galvanometer is normally calibrated directly to show percentage CO₂.

The gas and air chambers are drilled in heavy metal blocks to ensure the maintenance of a constant temperature while the effect of water vapour is compensated by saturating the gases before entering the indicator. A section of a CO₂-measuring instrument, shown in Fig. 5, illustrates how the influence of the rate of gas flow on the readings may be minimised by arranging the actual

measuring chambers as a shunt to the main gas and air channels.

The advantages of this type of gas analysis apparatus are: (1) Continuous readings are obtained, separate sampling and chemical analysis being unnecessary.

(2) Changes in composition may be rapidly detected, the time lag being low.

(3) The instruments are robust, withstanding normal operating conditions.

(4) Maintenance is very slight and no additions of chemicals are required.

(5) The analyser is fitted in any convenient spot close to the sampling point while the indicator and recorder may be located where they are most useful. Transmission from analyser to indicator and recorder does not involve any additional plant. This flexibility is a very important feature.

Certain disadvantages are inherent in the process: (1) As explained earlier special care must be taken in the design and operation of the instrument to minimise heat loss from the spiral by radiation and end-conduction.

(2) No direct chemical measurement of the CO_2 content is possible.

(3) Variation in the speeds of the gas and air flow have an effect on the values obtained.

(4) The presence of unburned hydrocarbons or hydrogen have a deleterious effect on the platinum of the spirals.

A complete outfit for permanent installation on a boiler must comprise: (a) a gas filter in the flue, (b) the aspirating and cooling unit, and (c) the analyser and indicator. The filter, consisting of a porous refractory tube (usually

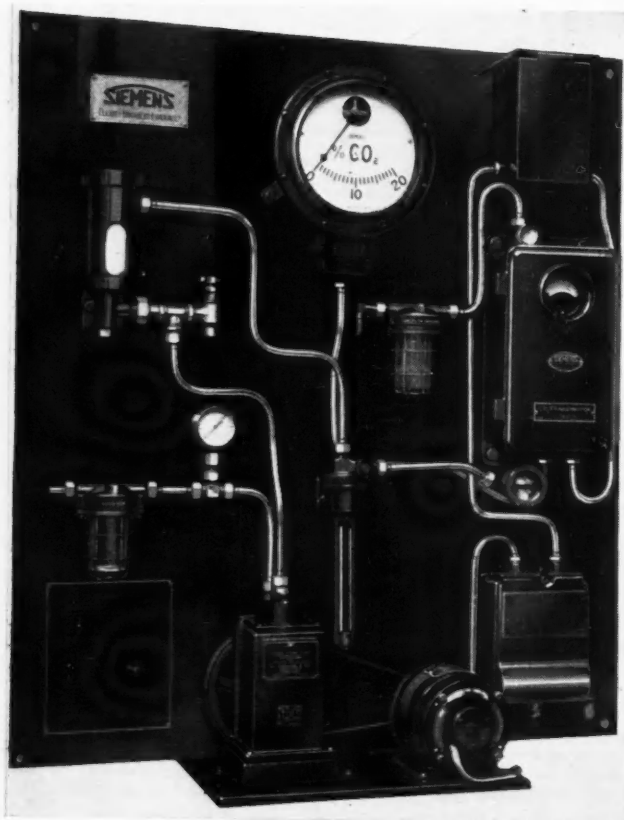


Fig. 4. CO_2 analyser and indicator complete with pump, as employed in certain marine installations.

(By courtesy of Elliott Brothers (London) Ltd.)

alumina) in a cast-iron holder, is inserted at a selected spot in the flue where the temperature is between 200° and 600° C. Gas from the flue is drawn through the filter, cooled to atmospheric temperature and saturated with water vapour by a combined aspirator and cooler of tubular construction. Air from the atmosphere is also drawn through parallel tubes in the aspirator so that gas and air both brought to the same temperature and humidity pass together to the analyser. The quantity of gas required by the analyser for correct readings is approximately $\frac{1}{2}$ cu. ft./hour, corresponding to a flow rate of 24 ft. per minute in the $5/16$ bore pipe normally used. To avoid corrosion tellurium-lead pipes are usually employed for the gas connections in the general lay-out.

In the design and lay-out of any system of CO_2 measurement there are a number of factors constantly to be borne in mind. Attention to these will ensure continuously accurate results from the equipment, while neglect of the important part they play will render suspect the values obtained from the most highly sensitive instrument.

(1) The volume of gas involved in continuous analysis is small, the tubing used for connections should therefore be of small diameter, short and as straight as possible.

(2) The striations of the gaseous components in flue gases make uniform composition impossible over any given cross-section of the flue. Spot tests should be carried out at different places until the most suitable sampling point is found.

(3) All connections should be gas-tight or infiltration of air will seriously affect the accuracy of the results.

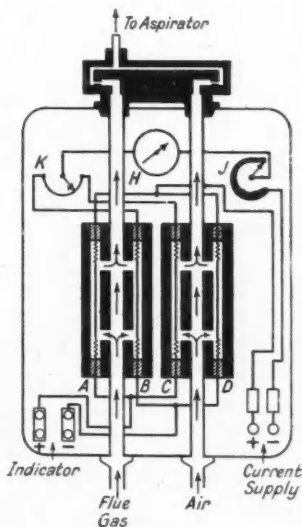
(4) The material from which the connecting tubes are made should be unaffected by the gases. Porcelain or tellurium-lead are commonly used. (At temperatures above 425° C. iron reacts with CO_2 and water vapour).

(5) The liquids used in the instrument should not absorb CO_2 . This point requires careful consideration in view of the common use of aspirators to withdraw the samples, CO_2 being very appreciably soluble in ordinary water.

Acknowledgments

The author is indebted to the following firms who have supplied technical data and photographs of the CO_2 measur-

ing instruments they manufacture: Electroflo Meters Co., Ltd.; George Kent, Ltd.; Elliott Brothers (London), Ltd.; International Gas Detectors, Ltd.; Bailey Meters and Controls Co., Ltd.



[By courtesy of Elliott Brothers (London), Ltd.]

Fig. 5. Section of CO_2 analyser and transmitter.

A, B. Gas chambers; C, D. Air chambers; H. Milliammeter; J. Adjustable resistance for bridge circuit; K. Zero adjusting resistance.

FUEL ECONOMY EXHIBITION

A feature of the Fuel Economy Exhibition which was opened recently by Mr. Tom Smith, M.P., Joint Parliamentary Secretary to the Ministry of Fuel and Power, at Harrods, Ltd., Brompton Road, London, is a chart which shows examples of by-products which are obtained from coal. A large piece of coal takes the centre position and leading from this are red cords which direct the eye to bottles of dyes, medicines and household cleaning products. Explosives are represented by the model of a shell, while a picture of an Army lorry indicates that benzol comes from coal. The exhibition is bringing hundreds of inquiries and suggestions which are being dealt with by officials at the exhibition and by the Ministry of Fuel.

Phenol Recovery

New German Waste Liquor Process

A NEW process for the recovery of phenol from waste liquors of hydrogenation and low-temperature carbonisation plants has been developed separately by I. G. Farbenindustrie and the Lurgi company, which have pooled their knowledge and now sell through the latter company a new product, "Phenosolvan," for phenol extraction. "Phenosolvan" is described as a mixture of different aliphatic esters with optimum extraction properties. Compared with other solvents previously used for phenol recovery from waste liquors it has the great advantage that it is profitable at very low phenol concentrations; as little as 3 or 4 gm./litre can be extracted in an economic way. A large-scale plant has now been erected for the treatment of a mixture of hydrogenation and low-temperature carbonisation water with 4 gm. of phenol per litre; the plant has a capacity of 30 cu. m. of waste liquor per hour and reduces the phenol contents to 0.05-0.08 gm. This is still too high a percentage to permit disposal into rivers, and further treatment is necessary to extract volatile fatty acids and other detrimental substances. Part of the "Phenosolvan" used is recovered by distillation with steam, so that the "Phenosolvan" consumption is less than 200 gm. per cu. m. of water.

The process was developed in the first place for use in the I.G. hydrogenation plants, but the demand for the recovery of phenol from other coal processing plants is so urgent that it is now being applied in other directions. As the output of the various coal-oil plants increases, the output of by-products also grows. There is evidence of an increasing interest in the development of processes for their improved utilisation. Thus it is reported that low-temperature carbonisation companies are experimenting with the conversion of gas produced in small quantities during the process and hitherto used only for heating into town gas for lighting and cooking.

FERTILISERS

As from September 1, 1942, gardeners and allotment-holders will be allowed to acquire small quantities of phosphatic and potassic fertilisers without permit or licence. This is one of the main effects of a new control order issued by the Ministry of Supply. The Order is the Control of Fertilisers (No. 24) Order, 1942, and copies can be obtained from H.M. Stationery Office, York House, Kingsway, London, W.C.2, or through any bookseller (price 1d.).

Oil from Coal

New Experimental Plant in U.S.A.

A FAR-REACHING study of practical and economical methods for producing liquid motor fuels and lubricants from coal will be undertaken by the U.S. Bureau of Mines at Pittsburgh, as soon as a new experimental plant just authorised by Congress can be erected and equipped, it is announced by Dr. R. R. Sayers, Director of the Bureau. The advantages of the Fischer-Tropsch method for current purposes—to provide economical and easily-built units for United States military outposts such as Alaska—are self evident, it is stated. The smallest economical unit of the hydrogenation method is about 150,000 tons a year capacity, while a Fischer-Tropsch plant of 30,000 tons a year capacity may be operated economically. A smaller amount of precision machinery is required in the Fischer-Tropsch process and almost any type of coal can be used successfully. Certain coals, because of high ash content or sensitivity to temperature variations, offer serious operating difficulties in the hydrogenation method.

SILVER IN INDUSTRY

Among the many effects produced by silver on a large range of alloys containing silver usually in quite small proportions, are those on machinability and bonding quality. An American report summarises the position as follows: "Solid solutions of homogeneous structure and pure metals are machined with considerable difficulty because the machine turnings do not break off freely and tend to clog the cutting tool. The presence of a finely divided phase, such as lead in brass or sulphides in steel, contributes to improved machinability. Somewhat the same effect is observed in stainless steel and those alloys containing an excess of silver beyond the limit of solid solubility. By bonding quality is meant the intangible factors involved in brazing and soldering associated with fluidity, capillary flow, and alloying characteristics. Silver added to lead imparts good soldering characteristics, and silver in brass makes a superior brazing alloy. A welding rod of copper containing 1 per cent. of silver has superior welding characteristics also."

A report from Mexico states that President Camacho had signed a decree prohibiting the taking of silver from Mexico. It was thought that this might refer to the taking of silver by travellers out of the country and not to purchases by the U.S. A Vichy message stated at the same time that "Mexico had banned the export of silver."

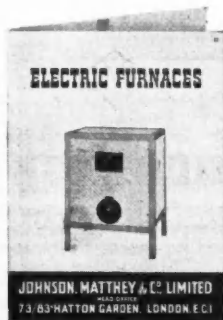
Metallurgical Section

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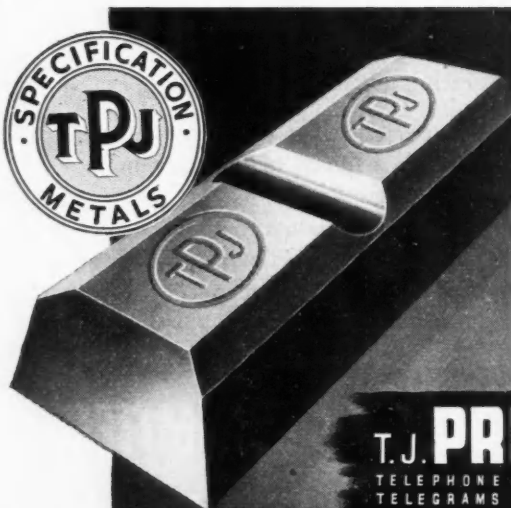
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Metallurgical Section

September 5, 1942

Sponge Iron

Merits and Demerits of a Scrap Substitute

P LANS for an immediate study of the various methods of producing sponge iron—an acceptable substitute for scrap iron in manufacturing steel—and for the erection of pilot plants to guide future operations in this field, have been launched by the U.S. Bureau of Mines, according to Dr. R. R. Sayers, Director of the Bureau. Funds totalling \$600,000 have just been made available by Congress to develop methods of utilising untouched iron ore deposits and to assist in alleviating a shortage of scrap iron.

Sponge-Iron Processes

Sponge iron—so-called because it is granular and porous—is the product of a process whereby metallic iron is obtained directly from iron ore without going through the liquid stage such as that employed to produce pig iron in a blast furnace. With natural gas or coal as the reducing agent, the oxygen is taken away from the ore at a temperature below the melting point of the iron or the iron oxide. The process is adaptable to smaller and therefore less expensive plants than the standard blast furnace installation, and produces an iron which is low in carbon. A number of sponge-iron reduction processes are known to be workable, but none of them has been applied commercially on a large scale to United States iron ores because the standard reduction methods have produced a sufficient supply of iron in the past.

Past experiments of the Bureau of Mines and of others have shown the practicability of reducing iron ore directly with reformed natural gas or coal, and it is with these two processes that initial work will be concerned. As long ago as 1927, the Bureau of Mines investigated the direct reduction of iron ores, and in 1936 the Bureau published a bulletin describing sponge-iron experiments in California conducted by Charles G. Maier, an engineer of the metallurgical division, with reformed natural gas as the reducing agent. This is known as the "gaseous reduction process," which means reduction with carbon monoxide or hydrogen. The carbon monoxide passing over hot ore reacts with the oxygen in the iron ore to form carbon dioxide and produces metallic iron. Coal of the non-coking type

--and therefore less expensive--can also be used in another direct reduction process.

As preliminary study is undertaken to determine which of the various processes is most suitable to current needs, the Bureau plans to make a survey of possible locations for two 30- to 50-ton-a-day pilot plants to test the various methods. The furnaces and other equipment in these pilot plants are expected to cost about \$500,000 and to provide practical means of determining how and where large-scale industrial plants may operate successfully.

Because of its low carbon content, sponge iron is an excellent substitute for scrap iron to mix with ordinary pig iron in manufacturing steel. Sponge-iron plants can be built on a smaller scale than blast furnaces, and small deposits of ore—too small to supply a modern blast furnace—can be used to supply ore to a sponge-iron plant. High-purity soft iron, containing only a small percentage of silica and free from carbon, is being demanded by electrical manufacturers particularly for armatures. Iron produced by the gaseous reduction of high-purity iron oxide should provide this necessary war material. The installation of sponge-iron plants in the United States would not interfere with the operation of the blast furnaces producing pig iron for the successful prosecution of the war. They would permit the continued operation of the large blast furnaces in the steel mills, and in continuing the fullest operation of open-hearth furnaces, and provide iron with special properties for other uses.

Scepticism and Opposition

This project has already met with some scepticism and opposition among practical steel men, who point out that the Germans tried the sponge process and discarded it and that Krupp in Essen experimented with the sponge process for some time. Professor Trinks, of the Carnegie Institute of Technology, designed a sponge-iron furnace in 1926 for Japan, but the equipment required is costly and a great deal of it is needed. Further, if the process had been efficient or practical, sponge-iron plants might well have been erected all over Germany, but blast furnaces were built instead.

The sponge process has also, according to

reports, been tried and discarded in the United States. The United States Steel Corporation erected an experimental sponge-iron plant but later dismantled it. Despite 25 years or more of research work on the process, it is said to have never worked out economically. If it had, the chances are that it would have been adopted by the steel industry, whose foresightedness in preparing for economic cycles by the adaptation and installation of practical production equipment is well known.

Most steel companies are no doubt well acquainted with the sponge-iron process, and their general attitude and conclusions are that no advantage is offered by this iron method where there is an adequate supply of raw material for blast-furnace operation. The contention of experts in the steel industry has been that the direct reduction method entailed in the sponge-iron process is not yet proven or ready for commercial use, but that they are not blind to its possibilities if the process could be efficiently and practically applied. Investigation would imply numerous plants for sponge-iron production, which would call for the

equipment of large-scale installations, diversion of labour, materials, cross-hauls of materials and decentralisation of iron supply conditions, which in time of war certainly do not present the most efficient basis for supplying metal to steel-making units. In the integrated operations of today, however, blast furnaces represent huge funnels for large tonnages of iron ore. Once pig-iron operations can be "set in the groove," production of pig iron or hot metal can be perfectly synchronised with the open-hearth and Bessemer furnace requirements without delay.

It would, however, be helpful to steel producers if it could be ascertained that scrap-iron and pig-iron supply could be economically supplemented to some extent by providing sponge iron wherever practical. But as the experience of many years in blast-furnace procedure, and the standardisation and co-operation leading to efficient integration with steel needs, are now being put to the test, under war conditions, it may yet be hoped that the studies and investigations on sponge iron will lead to some constructive information.

Buried Metals

Interim Report on Corrosives

THE Iron and Steel Institute has issued an interim report on researches on the corrosion of buried metals intended to precede the more extensive investigation contemplated by the Corrosion Committee in collaboration with The Institution of Civil Engineers. Experiments on various irons and steels buried in clay soils for three years, are described. The rate of general corrosion, even in these reputedly corrosive soils, was low, about 0.0015 in. per year, and no appreciable differences were found in this rate for ordinary ferrous materials, i.e., cast irons, structural steels, and wrought irons. The presence of low percentages of copper and/or chromium in steel or wrought iron had no effect on their resistance to corrosion under these conditions. It is shown that the experimental error is greater in this type of test than for corrosion tests under other conditions of exposure.

Work is also reported on a method of determining the relative corrosiveness of soils by following the change in the electrical resistance of buried coils of wire due to corrosion. It is demonstrated that the resistance can be determined in the soil itself and that this resistance increases proportionately to the corrosion. Although the results obtained may not be strictly representative of the behaviour of massive materials such as pipes, it is hoped that the method will prove a convenient means of comparing the corrosiveness of different soils.

Copper Dressings

Special Mixtures for Different Alloys

SPECIAL dressings for use with chill moulds in the casting of non-ferrous metals and alloys, are described by the General Metal Utilization Company, London. Extensive research by practical metallurgists has, it is stated, proved that usage of indiscriminate mixtures of uncertain composition (and particularly the practice of using one mixture for all alloys) is both unsound and unprofitable, and that much better and more constant results are obtained when the moulds are dressed with a smear specially compounded for the purpose. Among these they suggest a dressing specially adapted for the chill-casting of high-copper content brasses, bronzes, and gilding metal of highest quality (alloys from 70 per cent. copper upwards), where perfect soundness of the sheets, tubes, rods, etc., is an integral part of modern specifications, and a brass dressing designed for use when casting brass of the usual commercial qualities, ranging from brass solder (50/50) to the alloys having a copper content up to about 70 per cent., thus including manganese and other bronzes which come within this range of copper percentage and most of the alloys which are to be extruded, drawn, or hot-rolled. This, it is claimed, ensures non-oxidising conditions during pouring. A copper dressing is compounded to meet the special requirements for a mould dressing which will give a dense, clear casting, free from the porosity and surface irregularities that are commonly the bane of the refiner.

Recovering Brass from Metal Waste

Treatment of Buffings, Grindings and Metallic Dust

by A. G. AREND

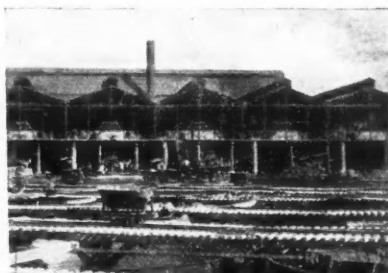
BEFORE entering into a description of methods adopted to-day for the reclamation of brass from buffings, grindings, and fine metallic dust, the conditions which prevailed prior to the war should be understood, so that a true criterion can be formed. In the first place, the conditions which obtained during the last war, when all kinds of odd scrap metals were melted and consumed in munition production, are largely absent to-day, because a much higher standard is expected from the finished metals, which in many cases have to perform high-duty operations. The result is that the authorities often specify electrolytic metals only, which can be relied upon to be free from impurities. Accordingly, many of the poorer grades of secondary metal, such as buffings, grindings, etc., are not as much in demand as formerly, when different firms of buyers offered keen competition.

Scrap Metals Substituted

In the refining process using reverberatory hearths, the scope for actually removing impurities was somewhat limited, and instead of additions of virgin metals as required, other scrap materials were substituted promiscuously. From the present-day aspect probably one of the worst examples of this was the addition of turnings and borings of white bearing metals, to replace losses of tin. This meant that an undesirable impurity in the form of antimony was deliberately included. What iron existed in the fine brass waste was often only imperfectly removed, despite preliminary treatment in the magnetizing machine. The brass refined thus contained both antimony and iron to begin with, while with a view to further economies, cheaply obtained Monel, and other nickel-silver alloys, though only added to the extent of a few pounds per ton, impoverished the physical properties of the product.

The utilisation of these nickel alloys, though they contained only some 30 per cent. of copper, and were added in such minute proportion, gives some indication of the lengths certain concerns were willing to go to ensure large profits without regard for name or reputation. The extent to which small "fortunes" were made during the last war was not fully realised until about 1920, when scrapped parts from dismantled warships came to hand for analysis. It is important to note that one reason which assisted the nefarious practice of including deleterious impurities was that rather than

pay the proper charge for full, or complete analysis, many smaller analytical chemists obliged by performing what were termed "proximate" analyses at a fixed figure for the contents of copper, tin, lead, and zinc only. The tin was determined by the gravimetric method in nitric acid solution, which meant that the resulting percentage included antimony, although this was not stated. As the zinc was taken by "difference," both nickel and iron could be present although no mention was made of them, and yet the resulting analysis could show



Refinery of a large smelting works.

100 per cent. It was often only when an actual dispute arose that a genuine complete chemical analysis was made, and this not infrequently caused something of a sensation.

One analysis of Admiralty gun metal, understood to contain 88 per cent. copper, 10 per cent. tin, and 2 per cent. zinc, showed 85.45 per cent. copper, 9.84 per cent. tin, 1.19 per cent. lead, 2.68 per cent. zinc, 0.19 per cent. iron, 0.05 per cent. nickel, and 0.60 per cent. antimony. The tin, which at that time was worth some £400 per ton, had thus been quite obviously replaced by white bearing-metal scrap. In other instances, the iron content rose to 0.85 per cent, and the nickel to over 0.20 per cent.

The following are other analyses of the same type of alloy in which tin and zinc were determined by the aforementioned convenient method, which shows how far the regular percentages were displaced; one of these was from a battleship scrapped after the last war.

| | 1 | 2 | 3 |
|-----------|--------|--------|--------|
| COPPER .. | 86.97% | 84.10% | 87.15% |
| TIN .. | 5.39 | 7.80 | 7.17 |
| LEAD .. | 1.05 | 2.39 | 4.39 |
| ZINC .. | 6.56 | 5.71 | 1.29 |

Lead in Admiralty gun metal is in excess.

able, as the physical properties are impaired, and the same remark applies to the widely fluctuating percentages.

As regards valve gun-metal, reputed to contain 85 per cent. copper, and 5 per cent. each of tin, lead, and zinc, the following are examples of the metal obtained from metalliferous brass waste.

| | 1 | 2 | 3 |
|-----------|--------|--------|--------|
| COPPER .. | 85.43% | 81.35% | 83.60% |
| TIN .. | 5.35 | 7.09 | 7.80 |
| LEAD .. | 6.72 | 6.61 | 3.44 |
| ZINC .. | 2.80 | 4.95 | 5.19 |

The fact that the tin content was high prevented rejection, while no mention was made of iron, of which closer analysis revealed as much as 0.20 per cent. thus making it possible for the resulting valves to "sweat."

A detailed account of other examples would only weary the reader, but, briefly, it was experiences of this kind after the last war that resulted in the specification of electrolytic, or at least virgin metals only for munition purposes in this war. It is for this reason that not a few firms are finding a certain difficulty at present in disposing of brass buffings, and grindings, etc., while the prices offered are not high, despite the fact that probably half the mass is represented by metallic material.

Nature of the Reactions Involved

In giving details of modern methods of reclaiming brass from this waste it has to be remembered that, during the "depression" years, certain firms worked out research methods in the hope that better times would return, and accordingly they could scarcely be expected to part with practical information to competing firms now that much metalliferous waste is available. Mention is therefore only made of an improved electro-magnetic separation method, whereby what are termed "non-magnetics" are removed from sand and abrasive material.

The smelting method is more general, but has seen much improvement of recent years. Formerly, when buffings and grindings were smelted in reverberatory hearths, the fine nature of the mass caused much loss by dusting; secondly, so many metallic particles were exposed on the surface that much burned off; thirdly, molten globules could not find their way through the sticky mass; and fourthly, the large amount of slag formed meant that a correspondingly high proportion of metal was skimmed off. Regarding the main chemical reactions, iron is oxidised and removed as silicate in the slag, but only provided that there is the necessary sufficiency of oxidation. In this respect the blast furnace offers better opportunities than the reverberatory hearth. On the other hand, the zinc of the brass when oxidised can also combine with the silica, forming one of the most

infusible silicates. During research investigations on the slag formed, it was ascertained that not infrequently the most infusible bisilicate of zinc existed. The disadvantage of slow melting in certain respects will thus be appreciated, though formerly every effort appeared to be made to slow down the work, evidently in the hope that the zinc would not be given the same opportunity to burn off.

The actual trouble really is that the slowly oxidised zinc is more prone to combine with the silica, whereas if the heat is excessive, such zinc is burned in the true sense of the word, and passes off to the flues as zinc fume, whereby there is less chance of it combining with the silica. Earlier claims that zinc could be reduced from the silicate by strongly heating with carbon and lime have to be taken with caution, as this does not apply with brass slags. More care has to be taken that the tin present is not lost, since it can be removed alike by a highly basic, or a highly siliceous slag, and the latter generally prevails with the material from buffings. Unlike ordinary ores, the high copper content, being in the metallic condition, oxidises in a different manner from sulphurised products; this also applies to the lead content, and the work thus differs from ore-smelting practice.

Instead of the reactions being of a plain, straightforward description, much lead oxide may oxidise a little copper, but alternatively, much copper oxide can oxidise a little lead. Provided that a good fume-collecting plant, preferably of the electrostatic order, is available, blast-furnace smelting proves much more economical in the long run than reverberatory treatment. This involves initial briquetting of the fine mass, a practice which is not so simple with the more springy turnings and borings. All material such as brass buffings, grindings, and fine metallic dusts, can be readily briquetted in machines designed for the purpose.

Modern Smelting Practice

In small factories, advantage is taken of the sand content of the buffings to add a small proportion of cement and mix the lot with water, allow to set, and then break up in the form of lumps for charging. With large refineries, a battery of briquetting machines is used, each of which is fed from hoppers, or conveyor-belt arrangements, but some of these deal with ores, and only certain of them are allocated to handling brass wastes, as the output from each passes to the blast-furnace.

One advantage of large-scale working is that, should a charge be unduly oxidised in the furnace, it can always be run into the converter where sulphur has to be removed from matter in any case. No such opportunities are offered to the smaller refiner

who has to depend on accurate allocation of different consignments, so that least burning, of the zinc, and yet high temperatures to ensure a fluid slag, and a good separation of the metal will be obtained. In preparing the briquettes from dry buffings, and grindings of fine disposition, about 10 per cent. of a binder is required, which sometimes need not exceed 2 per cent. water-glass, the latter depending on the pressure applied in the briquetting press. The briquetting press is best operated for lengthy spells at a time, to allow the finished product to be taken by hand-truck to a drying kiln, whence it passes to the stage of the blast-furnace by means of a hoist.

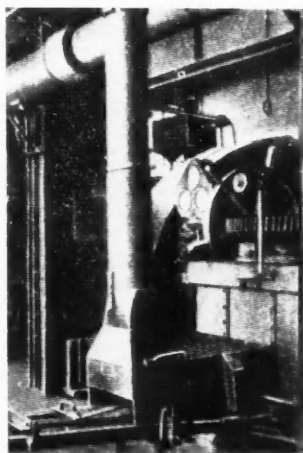
Although the square-sectioned blast-furnace is generally favoured for ore smelting, the more improvised cylindrical type of earth is preferred for smaller furnaces, despite the fact that more trouble is experienced when the water-jackets have to be replaced. As a rule, two of these furnaces are set-up side by side, with the one blast-projecting arrangement, as only one is operated at a time, while the other is kept at hand in good repair. At the start of a fresh run, old foul slags only are charged, together with coke, and when the temperature of the walls has been raised sufficiently, the briquettes are introduced by successive increments. The zinc of the brass, together with a certain proportion of the tin and lead, are appreciably oxidised, and pass through flues in a cooling system to the electrostatic separators, which function automatically.

Lithopone

No losses are thus sustained in this direction, as the collected fume is eagerly sought by lithopone manufacturers, who retain the tin which is separated by wet extraction. The only loss which might be serious is when the molten mass passes the line of the tuyères, as the resulting slag may absorb an unduly high proportion of oxides. So far as metallic globules are concerned, the careful addition of a small proportion of fluor-spar does not really harm the refractory lining, and assists easy melting, and other selected fluxes are also used.

Unlike ore smelting, where efforts are made to slow down the process, so that the reactions are given every opportunity to be perfect, the idea with the foregoing work is to run the mass through as soon as possible, since all zinc, lead, and tin temporarily lost, because of the high temperatures used, are eventually recovered. On the other hand, the fluidity conferred on the slag ensures a good cleavage, and any of the richer copper alloy which may be contained in it is soon given up. This action is furthered, because all slag is run to a settler-furnace with a conical bottom, which receives its heat from hot waste gases of the

other furnaces. The thin fluid mass thus can be cleaned completely from almost all traces of metal in a manner unknown in ore smelting. In the blast furnace, the slag runs continuously from an independent tap-hole to this settler, and at frequent inter-



A type of briquetting press used.

vals the metal which accumulates in the crucible is tapped into ladles. While still molten this metal is rapidly assayed, and any additions of tin, lead, or zinc are made as required, after which the mass is run into ingot moulds. What slag is run off during this tapping is also passed to the settler, so that there is little danger of any serious metallic loss throughout the process. Since the presence of arsenic would be highly detrimental to the brass ingots produced, ordinary speiss cannot be included in the charge, but a specially prepared white metal is used which absorbs the antimony. Thus the two principal impurities which can impair the metal, namely iron and antimony, are removed, and, though recovered from poor-grade buffings, and grindings, the resulting ingots represent a product sufficiently pure for all ordinary engineering purposes.

Mr. William Selby Simpson, Wynderoft, Old Park Road, Enfield, N., aniline dye manufacturer, who left £166,522 (net personalty £161,624), gave £10,000 to Enfield War Memorial Hospital for a new wing. Numerous other bequests included £2000 to the benevolent fund of the Institute of Chemistry.

Ball-Mill Improvement

Peripheral Discharge Adapted

PERIPHERAL discharge mechanism can now be applied to the ball or rod mills manufactured by the Denver Equipment Company, states a recent issue of *Deco Trefoil*. This discharge is a modification of the grate type, and is recommended where a positive gravity discharge is desired. It consists of openings in the shell into which bushings (with holes of the desired size) are inserted. The number of discharge holes will vary in proportion to the mill size. If, for any reason, the discharge through the openings should not be equal to the feed into the mill, such as during an overload or under extraordinary operating conditions, then the pulp will fill up and discharge through the trunnion overflow.

In some instances it may be desirable to discharge through both the peripheral holes and the trunnion. By this method the coarse granular product will pass through the peripheral discharge holes and the fine material will overflow through the trunnion. Outside the mill, flanges are used to attack a stationary discharge hopper to prevent splashing of the pulp.

HARDENING DRILL STEEL

In a paper read before the Canadian Institute of Mining and Metallurgy, Charles G. Kemsley describes an ingenious method of ascertaining the quenching temperature of drill steel in use at the Dome mines. At their mines in 1939 they purchased a few bars of an alloy steel for the purpose of testing its fatigue-resisting qualities as compared with those of a straight carbon steel then in general use at the mine. This steel has a tensile strength of 180,000 lb. per sq. in. and a Brinell hardness of 380, as compared with a tensile strength of 114,000 lb. per sq. in. and a Brinell hardness of 230 for the standard carbon drill steels, in the "as rolled" condition.

The result of this test showed that about five times as many runs could be obtained from the alloy steel before failure from fatigue. The management felt that some means should be developed to determine the quenching temperature without depending upon the operator's judgment of the correct "colour." With the assistance of the Canadian General Electric Company, a radiation-type vacuum thermocouple pyrometer was adapted to this purpose, with excellent results. The vacuum thermocouple in use is mounted in a housing furnished with a lens in the window opening to concentrate radiant energy on the thermocouple element.

Non-Magnetic Metals

New Gauge for Measuring Thickness

AN electrical gauge for measuring the thickness of non-magnetic metals when only one side of the metal is accessible has been developed by the General Electric Company, Schenectady. The gauge is accurate to within 5 per cent., measuring thicknesses up to $1\frac{1}{2}$ in., and can be used in measuring thicknesses of non-magnetic metals that are backed by magnetic metals. Brass sheeting, copper tanks, tubing, and pipes, and aluminium products, such as hollow aluminium aeroplane propellers, readily lend themselves to the use of this gauge.

When placed against a non-magnetic metal, the gauge head sets up eddy currents within the metal which change the impedance of the head and affect the circuit bridge balance. The eddy currents increase with the thickness of the metal, and the effects of these currents upon the circuit bridge, as shown by deflection of the indicating scale, are plotted upon a master curve for known thicknesses of a specific metal within the desired thickness range. When the gauge head is placed against the unknown thickness of the same metal, and the deflection read, the reading is compared with a similar point on the master curve to determine the thickness of the tested piece. It is, however, essential that the contour of the test piece be the same as that of the pieces of known thickness from which the master curve was obtained.

NIOBIUM ALLOYS

According to investigations by Wever and Peter, reported in *Archiv für das Eisenhüttenwesen*, a niobide can be formed in iron-niobium alloys, which on heating to high temperatures may be brought into solution. On tempering, the niobide is reprecipitated only when the temperatures exceed 500° C., then causing a marked increase in hardness. Iron-niobium alloys have a high fatigue value, if the niobium remaining in solution after quenching is effectively distributed on tempering at temperatures of 500°-700° C. The properties of the binary alloys are maintained in ternary, etc. Nb-bearing alloys, provide that the niobium content is sufficient after converting the carbon to niobium carbide to form the requisite amount of niobide.

The address of the Wrought Light Alloys Development Association in future will be: Union Chambers, 63 Temple Row, Birmingham, 2. The Registered Office of the Association remains at 25 Bennett's Hill, Birmingham, 2, to which all communications for the secretary should be forwarded.

The Chemical Treatment of Textiles

Notes on War-Time Dressing and Finishing Practice

by A. E. WILLIAMS, F.C.S.

WAR conditions have caused a shortage of certain chemicals used in the textile trades, many of which materials were formerly imported from the Continent as proprietary products, and users in this country are not always fully acquainted with the composition of such materials. To these it is hoped the following notes may be of use. In the dressing and finishing of textiles certain oils and soaps are used with the object of facilitating the penetration of the fibres of the material by the dressing agent. As most dressing agents are of a colloidal character, many containing both starch and dextrine, the oil or soap must be present in them in the dispersed state in order to enable penetration to occur. It is necessary for the dressing agent to penetrate thoroughly into the fibres so as to impart a good appearance to the goods and to ensure their stability. Briefly, the addition of an oil or soap to the dressing makes the fabric soft and supple, and with heavily filled fabrics the oil or soap fixes the filler, preventing it falling away. Such fillers include gypsum, china clay, talcum, lead sulphate, etc. While for the glazing of fabrics a wax, such as paraffin wax, may be incorporated with the dressing. Dressing materials, in general, include many types of soaps: oils and fats, such as olive, castor and groundnut oils, palm and palm kernel oils, hog fat, blubber fat, bone oil, etc.; and such waxes as paraffin wax, spermaceti wax, beeswax, Japan wax, etc.

Soap-Fat Mixtures

In many cases mixtures of soaps and fats and waxes are used. The exact proportion employed is governed by the character and properties desired in the finished fabric. For example, the properties of smoothness, softness, pliability, elasticity, etc., are all controlled largely by the dressing employed. Generally speaking, coloured fabrics permit a wider range of dressing materials to be used than is the case with white fabrics, for with the latter some of the dressings which are in other ways suitable would discolour the fabric. Thus soaps containing resins cannot normally be used for white goods. A fat like palm kernel oil, which has a tendency to early rancidity, cannot be used in large proportions in the dressing owing to the danger of the formation of mould spots in the fabric. Such oils as castor and olive oils, which in peace time are largely used in dressings, have to a great extent, due to war conditions, been replaced by groundnut and similar oils. To-day, a dressing soap may consist of little more than a soap made from groundnut oil and containing a large excess

of the oil. As a softening material for coarse goods one may use a Turkey red oil, or a mixture of soap and glycerine. For finer fabrics only highly refined oils and fats are used.

In compounding a dressing the filling agents are first placed in hot water and boiled and the fatty components added, but Turkey red oils are usually added after boiling operations are concluded. Incidentally, it may be noted that the cheaper classes of sulphonated oils may impart an unpleasant odour to the fabrics when the latter have been stored for some time. The starchy portion of the filler is usually potato starch and a dextrine from either this or another starch, while magnesium sulphate may often take the place of lead sulphate. In compounding these the sulphate and starch materials are first dissolved separately in water and brought to the boil, then cooled to 40°-50° C. before mixing together. Such a mixture may then be added to a textile soap which has been previously dissolved in water, and the whole agitated for ten minutes. A typical dressing for coloured goods may be made up by using dextrine 150 to 200 parts by weight, magnesium sulphate 150 to 200, textile soap five to twelve parts. A dressing to give a glossy finish to fabrics may be made up of ten parts soluble starch, seven parts glucose syrup, one part paraffin wax, one part palm kernel oil, and two parts textile soap. In such a compound when soluble starch is not available this may be prepared on the premises either by heat treatment of ordinary starch, or by acting on the latter with a small proportion of an acid such as hydrochloric acid; while for paraffin wax beeswax may be substituted, and for palm kernel oil coconut oil is the appropriate substitute. For white cotton goods a typical dressing consists of starch 50 parts, china clay or talcum 30, barium or lead sulphate five, soap one part, palm kernel oil two parts, with a trace of ultramarine.

Fulling

The process of fulling has for its object the physical treatment of the fibres in such a way that the finished material is close and compact. Before the process of fulling the fabric receives a preliminary wash, for the purpose of removing the oily dressing used in the spinning operation, both sodium and potassium soaps being used in the preliminary wash. These soaps are made up with a large proportion of oleic acid, since the soap solution must be completely liquid at a temperature of about 6° C. In the fulling process only those soaps are suitable which form a viscous semi-solid mass at the temperature of fulling,

i.e., 20°-30° C. Such soaps are normally produced from tallow, bone fat, or palm oil, but in war time increasing use is being made of whale oil fatty acids. The method adopted in fulling depends on the type of material being treated, and may be applied to the surface of the material only or to the interior as well.

Surface treatment is usually applied only to materials which have not to withstand any harsh after-processing, and the soap solutions used are relatively weak, about five per cent. strength. While stronger soap solutions, ten per cent. or more, are applied to materials which must receive interior penetration of the agents. Soaps made from whale oil and from bone oil are in use for comparatively coarse goods, but for finer materials soaps from tallow or palm oil are in general use. The process of fulling may take place in the cold or at a slightly elevated temperature. In the former case the heat generated by the friction of the material against the various mechanical appliances used in the process is sufficient.

In general, two classes of fulling soaps may be distinguished: (1) those which when cold remain liquid or semi-liquid, without the addition of water or of sodium carbonate solution, and produced from bone oil, oleine, etc.; (2) those which do not solidify when diluted with water or sodium carbonate solution to the usual strength used in fulling, and produced from wool fat, palm oil, sulpho-nated oils, etc. Other points in fulling soaps which have to be considered are neutrality and odour. For the finest wool products the soaps should be perfectly neutral, but for the lower qualities of materials the presence of free alkali in relatively large amounts is considered to be advantageous. With coloured goods, dyed previous to fulling, the possible effect of free alkali on the dyes has to be considered.

Removal of Odour

In regard to odour, soaps made from either bone oil or whale oil fatty acids direct tend to leave a characteristic odour in the treated fabric. This problem is solved either by a thorough after-washing of the goods, or by making soaps only from distilled and highly-refined fatty acids of these two oils. In some factories it is possible to make a fulling soap by acidifying the waste soapy water from other textile processes and re-using the products for soap making. Such waste soap solutions often carry large proportions of unsaponifiable constituents, and these are eliminated by distilling the fatty acids resulting from the acidification of the waste water. The presence of much unsaponifiable matter in fulling soaps leads to such matter becoming ingrained in the fabrics treated and affects the succeeding dyeing processes.

In applying dressings and other chemical preparations to fabrics precautions have

always to be taken to ensure that little or no material of an acid character touches the fabrics. Even traces of mineral acid, when dried into the fabric, considerably weaken the fibre, for the mineral acid hydrolyses the cellulose. Acetic acid and formic acid do not affect the fibres appreciably, but oxalic acid, tartaric acid, and similar acids have a more pronounced effect. In practice, therefore, goods containing acid should not be laid in a pile to dry, nor exposed to direct sunlight. The operator should ascertain, by means of suitable indicators, that the material is made entirely free from acid by washing, before drying. Acids almost always affect the fabrics unfavourably, their action depending on the conditions present. When a fabric, containing slight traces of acid, has been stored for any length of time, particularly in a warm place, it is impossible to neutralise the acid by an alkaline dressing. In the decomposition of the cellulose of the fabric a series of intermediate substances is produced.

Decomposition Products

Besides unchanged cellulose, which retains the structure of the original fibre, may be found hydrocellulose, and cellulose-dextrine, which products are both capable of being reduced to sugar. The properties of these decomposition products depend on the conditions under which they are produced. Free acid in the fabric may generally be recognised by the aid of litmus or methyl orange. A moist indicator paper is placed flat on the cloth and held in position by two glass plates, which are weighted to give additional pressure. It should be observed, however, that oxycellulose and hydrocellulose also give a weak acid reaction. Bleached linen generally gives a slight acid reaction even after previous soaking in dilute cold ammonia solution. The action of acids is first to harden the fibres of the material, but a softening results later, either on the application of heat, or when the acid has been stored with the cloth for some time.

A brief heating of a sample of the cloth at 120° C., or better still, a heating for one hour at 100°-110° C., followed by tests of mechanical strength, will show whether the fibre has been converted to hydrocellulose to any appreciable extent or whether an organic acid, which is comparatively harmless, is present. The fibres possess the property of tenaciously retaining small amounts of acid, and it is quite possible for such acid to be present and yet give no acid reaction when washed with cold water. The acid may, however, often be removed by repeated washings with warm water. The detection of free acid in the fibre is not always easy, for the fibre may have been afterwards treated with alkali. Nevertheless, hydrocellulose may still be present, likewise oxycellulose. The Nessler reagent is the best for distinguishing between oxy- and hydro-cellulose.

General News

Plastics made of acrylic resins which have proved entirely satisfactory are to replace rubber for dentures made after October 3.

To stimulate the salvage effort of its 230,000 employees, the L.M.S. Railway Company has organised a mobile salvage exhibition which is at present on a 10,000-mile tour of Britain.

The Ministry of Food announce that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users for the four weeks ending September 26.

The Export of Goods (Control) (No. 35) Order, 1942 (S.R. & O. 1942, No. 1676), prohibits, except under licence, as from September 14, all exports to Aden, Anglo-Egyptian Sudan, Cyprus, Egypt, Palestine, and Trans-Jordan.

Once again "600," the magazine of George Cohen, Sons and Company, Ltd., has made its appearance. This 1942 number is as bright as ever, full of apt jokes and brightly written articles and as well illustrated with line drawing and photographs as could be wished.

At the end of July Londoners had raised £425,000 for the Red Cross Penny-a-Week Fund. Of this approximately £360,000 was contributed by men and women workers at their place of employment, the remainder being raised through house-to-house collections.

An amusing cricket match took place recently between a provincial team of Imperial Chemical Industries' players and the W.A.A.F. in which the I.C.I. team played left-handed. The W.A.A.F.'s won "aided by fifth column work on the part of the umpires."

Dr. Levy, of Imperial Chemical Industries, Ltd., being unable to attend the meeting of the Harrogate Discussion Group last week as arranged, to speak on "Science and Post-War Reconstruction," Dr. Douglas Clarke, of Leeds University, gave a talk on "Chemistry in Daily Life." Dr. Clarke pointed out the immense debt owed to the incessant labours and researches of chemists and the dependence upon the products and applications of chemical science.

The first delegate representing organised scientific workers to attend the T.U.C., which meets at Blackpool from September 7 to 11, will be Mr. J. A. Henley, B.Sc., A.M.I.E.E., representative of the Association of Scientific Workers. Mr. Henley is part author with Prof. MacGregor Morris of a book on the Cathode-Ray Oscillograph. He will speak in connection with a resolution dealing with synthetic rubber.

From Week to Week

In an article in THE CHEMICAL AGE, of August 22, 1942, "Dust-Determination Advances," by S. C. Blacktin, Ph.D., M.Sc., three errors occurred on page 189. In the first line under the cross-heading, "Typical Examples," "1 mm" should read "1 sq. mm"; in the second line "0.5 mm" should read "0.05 mm"; and in the twentieth line "2e m = L" should read "2e cm = L."

Foreign News

Large aluminium deposits are reported to have been discovered in the provinces of Yunnan and Szechwan, in Western China.

Mass arrests by the Nazis of foreign workers in a chemical works in Bochum, in the Ruhr, have followed four explosions there, the Soviet Information Bureau states.

After many months of experiment, the American Can Company has developed a method for the making of cans with fibre bodies on machines used for the manufacture of metal containers.

A £100,000 electrodevelopment laboratory, where U.S. metallurgists plan to study the recovery and processing of minerals from the Pacific Northwest with electrical energy from Bonneville and Grand Coulee Dams, is to be established in that region within the near future. Improved methods of recovering magnesium and aluminium from the plentiful natural resources of that area, together with research in the processing of tungsten, chromium, manganese, vanadium and other strategic and critical minerals, are to be the chief objectives.

Forthcoming Events

A meeting of the Midland Association of Gas Engineers and Managers will be held on September 10, at 2.30 p.m., at King Edward House, New Street, Birmingham, when, in an informal address, Mr. E. V. Evans, chairman of Council, The Gas Research Board, will deal with the function of chemistry in the gas industry.

On September 22, at 11 a.m., in the lecture theatre of the Royal Institution, 21 Albemarle Street, London, W. 1, the Institute of Physics will hold a discussion on the determination of equilibrium diagrams by X-ray methods. An introductory statement will be made by Sir Lawrence Bragg, F.Inst.P., F.R.S. (president).

Company News

The British Oxygen Co., Ltd., is maintaining its interim dividend of 7 per cent. on the ordinary capital.

Chemical and Allied Stocks and Shares

ALTHOUGH less active the undertone in most sections of the Stock Exchange has been steady and British Funds maintained their recent further gains. Most shares of companies connected with the chemical and kindred industries held their recent improvement. At 33s. 3d. Imperial Chemical were 3d. better compared with a week ago, sentiment being aided by general market confidence that the forthcoming interim dividend is likely to be maintained. I.C.I. 7 per cent. preference were quoted at 33s. B. Laporte were again 66s. 3d. "middle." W. J. Bush were 45s. and elsewhere, Fison Packard remained around 38s., while Cooper McDougall & Robertson shares changed hands at 24s. 3d. at one time. Cellon 5s. ordinary received some attention and were dealt in up to 15s. 3d., while Greef-Chemicals Holdings 5s. ordinary transferred around 5s. 6d. Monsanto Chemicals preference shares were again 22s. 6d., Lawes Chemical 8s. 9d., British Drug Houses 18s. 9d., and Burt Boulton & Haywood 15s. In other directions, British Glues & Chemicals 4s. shares were dealt in at 6s. 3d., and the participating preference up to 30s.

British Oxygen were slightly lower at 65s. 9d., but this reflects deduction of the interim dividend from the price. British Aluminium were 3d. better at 45s., while British Match further improved from 35s. 3d. to 35s. 9d. Dunlop Rubber ordinary units at 28s. were unchanged on balance, Barry & Staines further improved from 33s. to 34s. 3d., and Turner & Newall were well maintained at 68s. 9d. General Refractories were easier at 13s., but have held most of their recent rise. Imperial Smelting remained at 11s. 6d., and British Plaster Board at 26s. Stewarts & Lloyds were firm at 47s. 9d. Tube Investments were higher at 86s.; small gains were recorded in a number of other iron, steel and allied securities. Calico Printers issues were steady on the payment announced in respect of preference dividend arrears, and other textile issues were maintained. British Celanese and Courtaulds were better. There was again a fair amount of activity in shares of companies identified with plastics. British Industrial Plastics 2s. ordinary transferred up to 5s., and Erioid up to 11s., while business at 2s. 8d. was shown in Catalin 5s. shares. Lever & Unilever rose from 28s. 9d. to 30s. 3d. awaiting the dividend announcements.

In other directions, Boots Drug made the higher price of 36s. 3d., and Triplex Glass were firm at 33s. 9d. pending the dividend statement. United Glass Bottle were again quoted at 55s. and Low Temperature Carbonisation 2s. shares were dealt in

around 1s. 7½d. Business at 26s. was shown in Morgan Crucible first preference, and at 23s. in the second preference. United Molasses were better at 28s. 3d., while the units of the Distillers Co. were firm at 79s. Borax Consolidated were steady at 33s. the market being hopeful that the dividend for the year ending this month may be kept on a 7½ per cent. basis. Leading oil shares were better on balance.

British Chemical Prices

Market Reports

QUIET conditions have recently been in evidence in some sections of the market, which can be accounted for by the usual tendency towards slackness at this time of the year. However, during the past week increased activity has been noticeable. Prices remain unaltered and in the soda products section only small quantities of prussiate of soda are available, whilst a fair demand is reported for nitrate of soda and acetate of soda. Most of the potash products are available in restricted quantities with nominal prices ruling for yellow prussiate of potash. A strong market is reported for oxalic, tartaric and citric acids with quotations at recent levels. The coal-tar products section is quiet.

MANCHESTER.—Firm price conditions have continued on the Manchester chemical market during the past week. There has been a fair amount of new inquiry in circulation and in the leading heavy products additions to order-books have been reported, chiefly on home account, export bookings having been restricted. On the whole, sellers have had little of which to complain regarding the rate at which contract supplies are being taken. In the by-products market values are well held.

GLASGOW.—In the Scottish heavy chemical trade during the past week there has been no change. Home business maintained its steady day to day transactions. Export business was difficult. Prices generally remain firm.

By agreement with the Ministry of Supply the following maximum selling prices for Canadian crude arsenic in the U.K., ex wharf, or ex warehouse, have been fixed until further notice: 5 tons or over, £25 per ton; 2 to 5 tons or over, £25 10s.; 1 to 2 ton lots, £26 10s.; under 1 ton lot, £28.

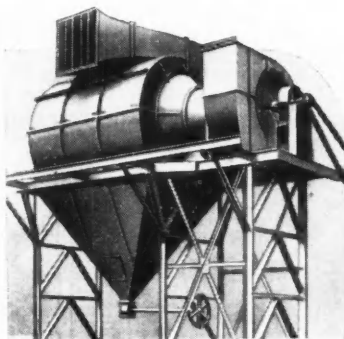
MR. NORMAN NEVILLE has been appointed to act as director of the British Chemical Plant Manufacturers' Association because of the continued absence of Mr. Davidson Pratt on Government service. Mr. W. A. Williams continues as acting secretary.

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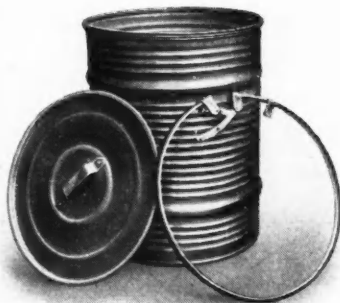
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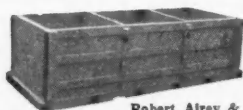
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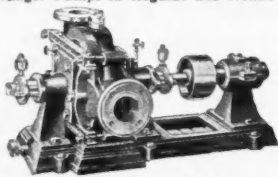
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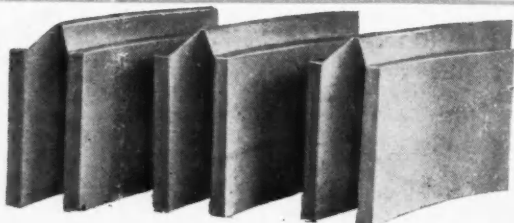
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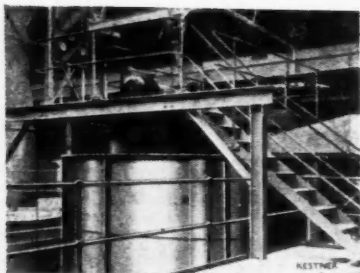
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